

Patent  
USA.229

**Amendment to the claims:**

1. (original) A method for dispensing a build material in a flowable state from a dispensing device of a solid freeform fabrication apparatus to form a three-dimensional object, the method comprising the steps of:

providing at least one queue station for holding a plurality of discrete amounts of build material in a non-flowable state;

loading the plurality of discrete amounts of build material in a non-flowable state to the queue station, the discrete amounts of build material residing in the queue station in a random order;

delivering the discrete amounts of build material from the queue station to at least one hopper on the dispensing device;

changing the build material from the non-flowable state to the flowable state after delivery of the build material to the hopper;

moving the build material in the flowable state in the hopper to a receptacle of the dispensing device; and

dispensing the build material in the receptacle by the dispensing device in the flowable state in a layerwise fashion to form the three-dimensional object.

2. (original) The method of claim 1 further comprising the step of:  
providing an environment for the build material to return to the non-flowable state after being dispensed in the layerwise fashion.

3. (original) The method of claim 1 wherein the step of delivering the discrete amounts of build material occurs in response to a low condition detected in the amount of build material held in the receptacle.

4. (original) The method of claim 1 wherein the step of moving the build material in the flowable state in the hopper to the receptacle is accomplished by capillary action.

5. (original) The method of claim 1 wherein the steps are separately performed for dispensing a support material, the support material forming supports for the three-dimensional object.

6. (original) The method of claim 5 wherein the step of dispensing the build material and the step of dispensing the support material is performed by at least one ink jet print head.

7. (original) The method of claim 5 wherein the steps are separately performed for a plurality of different build materials, each different build material being associated with a unique visual characteristic.

8. (original) The method of claim 7 further comprising the step of including a color additive in each different build material to establish the plurality of different build materials.

9. (original) The method of claim 8 wherein the color additives are indicative of the colors consisting of cyan, magenta, yellow, and black.

10. (original) A build material feed system for a solid freeform fabrication apparatus, the build material having a non-flowable state and a flowable state, the apparatus having a dispensing device for dispensing the build material, the feed system comprising:

means for holding a plurality of discrete amounts of build material in a non-flowable state;

means for delivering the discrete amounts of the build material in the non-flowable state

Patent  
USA.229

to at least one hopper on the dispensing device;

means for changing the build material from the non-flowable state to the flowable state after delivery of the build material to the hopper;

means for moving the build material in the flowable state in the hopper to a receptacle of the dispensing device;

means for dispensing the build material in the receptacle by the dispensing device in a layerwise fashion.

11. (original) The build material feed system of claim 14 further comprising means for detecting a low condition of build material held in the receptacle for controlling the delivery of the discrete amounts of build material to the hopper.

12. (original) The build material feed system of claim 15 wherein the means for moving the build material in the hopper to the receptacle comprises a passage in the dispensing device, the passage being in communication between the receptacle and the hopper.

13. (original) The build material feed system of claim 12 wherein the dispensing device has at least one discharge orifice in communication with the receptacle, the discharge orifice having a capillary force, and the passage comprises a capillary valve having an effective capillary force greater than the capillary force of the discharge orifice and the receptacle of the dispensing device is maintained at sub-atmospheric pressure.

14. (original) The build material feed system of claim 10 wherein the dispensing device comprises at least one ink jet print head having a plurality of discharge orifices.

15. (original) The build material feed system of claim 14 wherein the dispensing device comprises at least two hoppers, at least one hopper adapted for receiving the build

material to be dispensed to form the three-dimensional object, and at least another hopper adapted for receiving a support material to be dispensed to form supports for the three-dimensional object.

16. (original) The build material feed system of claim 10 further comprising at least two dispensing devices, at least one dispensing device for dispensing the build material forming the three-dimensional object and at least one dispensing device dedicated to dispense a support material to form supports for the three-dimensional object.

17. (original) The build material feed system of claim 10 wherein the dispensing device comprises a plurality of hoppers, each hopper being associated with a different build material having a unique visual characteristic and being delivered the build material indicative of the unique visual characteristic.

18. (original) The build material feed system of claim 17 wherein the unique visual characteristic associated with the hoppers is color, and a color additive is provided in the different build materials delivered to the hoppers.

19. (original) The build material feed system of claim 18 wherein the color additives are indicative of the colors consisting of cyan, magenta, yellow, and black.

20. (original) The build material feed system of claim 19 wherein the dispensing device has a plurality of discharge orifices that can selectively dispense the build material with any color additive to any coordinate in any layer of the three-dimensional object.

21. (currently amended) The build material feed system of claim 10 wherein the means for delivering the discrete amounts of build material to the hopper comprises a mechanical indexer ~~the~~ that delivers the material in a drop-in-load manner.

22. (original) A solid freeform fabrication apparatus for forming a three-dimensional object in a layerwise fashion by dispensing a build material in a flowable state, the apparatus comprising:

- a build environment having a build platform for supporting the three-dimensional object while it is being formed;

- at least one dispensing device adjacent the build platform for dispensing the build material in the flowable state to form layers of the three-dimensional object, the dispensing device having at least one hopper for receiving the build material;

- at least one queue station for holding a plurality of discrete amounts of build material in a random order, the material residing in a non-flowable state;

- a motion means for moving the dispensing device and the build platform respectively when dispensing the build material;

- a means for delivering the discrete amounts of build material from the queue station to the hopper;

- a heating means in communication with the hopper for changing the build material from the non-flowable state to the flowable state; and

- a computer controller for receiving object data descriptive of the three-dimensional object, the computer controller adapted for processing the data in order to control the apparatus when forming the three-dimensional object.

23. (previously amended) The apparatus of claim 22 wherein the dispensing device further comprises:

- at least one receptacle for holding a volume of the build material in the flowable state;

and

wherein the discrete amounts of the build material are delivered to the hopper in response to a low condition detected by the computer controller in the amount of build material held in the receptacle.

24. (original) The apparatus of claim 23 wherein the dispensing device further comprises:

at least one discharge orifice in communication with the receptacle, the discharge orifice having a capillary force;

a passage in communication with the receptacle and the hopper, the passage including a capillary valve having an effective capillary force greater than the capillary force of the discharge orifice, the passage allowing the build material in the hopper that has changed to the flowable state to travel through the passage and into the receptacle; and

wherein the volume of build material in the receptacle of the dispensing device is maintained at sub-atmospheric pressure.

25. (original) The apparatus of claim 24 wherein at least one hopper is adapted for receiving the build material to be dispensed to from the three-dimensional object, and at least one other hopper is adapted for receiving a support material to be dispensed to form supports for the three-dimensional object.

26. (original) The apparatus of claim 22 further comprising at least two dispensing devices, at least one dispensing device for dispensing the build material forming the three-dimensional object, and at least one other dispensing device for dispensing a support material to form supports for the three-dimensional object.

27. (currently amended) The apparatus of claim 22 wherein the dispensing device further comprises a plurality of hoppers, each hopper being associated with a different build material having a unique visual characteristic and being delivered build material indicative of ~~the~~ of the unique visual characteristic.

28. (original) The apparatus of claim 27 wherein the unique visual characteristic of the build material delivered to each hopper is color, and a color additive is provided in the different build materials delivered to the hoppers.

29. (original) The apparatus of claim 28 wherein the color additives are indicative of any one or combination of the colors consisting of cyan, magenta, yellow, and black.

30. (original) The apparatus of claim 29 wherein the dispensing device comprises a plurality of orifices in communication with the hoppers such that all the different build materials can be selectively dispensed to any coordinate in any layer on the three-dimensional object.

Claims 31-66 (canceled)

67. (previously presented) The method of claim 5 further comprising the steps of: producing waste material from the dispensed build material and support material; and depositing the waste material in a waste receptacle associated with a container for removing the waste material.

68. (previously presented) The method of claim 67 further comprising the steps of: removing the container when the container has been filled to a desired level; and replacing the removed container with another container.

69. (previously presented) The method of claim 68 further comprising the step of:  
curing the waste material in the waste receptacle.

70. (previously presented) The method of claim 69 wherein the waste material is  
cured by exposing the waste material to actinic radiation.

71. (previously presented) The method of claim 70 further comprising the step of:  
closing the waste receptacle prior to ejecting the container.

72. (previously presented) The method of claim 5 further comprising the build  
material and support material being held in separate containers for dispensing the build material  
to form the three-dimensional object and for dispensing a support material to form support for  
the three-dimensional object.

73. (previously presented) The method of claim 72 further comprising the steps of:  
removing the containers when substantially all of the material in each container has been  
expelled; and

replacing each removed container with another container holding a discrete amount of  
material to be delivered to the dispensing device.

74. (previously presented) The material feed system of claim 15 further comprising at  
least one container being retained in a queue station in each hopper.

75. (previously presented) The material feed system of claim 74 further comprising  
heating means in each hopper to change the build material and the support material to the  
flowable state.



76. (previously presented) The material feed system of claim 75 further comprising the dispensing device dispensing layers formed from build material and support material to form the three-dimensional object and supports for the three-dimensional object .

77. (previously presented) The material feed system of claim 76 further comprising means for normalizing the layers of the three-dimensional object wherein waste material is produced.

78. (previously presented) The material feed system of claim 77 further comprising means for depositing the waste material in a waste receptacle associated with the container.

79. (previously presented) The material feed system of claim 78 further comprising: means for ejecting the container for build material and the container for support material when substantially all of the material in each container has been removed.

80. (previously presented) The material feed system of claim 79 further comprising: means for curing the waste material after the waste material is delivered to the waste receptacle.

81. (previously presented) The material feed system of claim 80 wherein the means for curing the waste material cures the waste material by exposure to actinic radiation.

82. (previously presented) The material feed system of claim 81 further comprising: means for closing the waste receptacle prior to removing the waste receptacle.

83. (previously presented) The material feed system of claim 67 further comprising: the means for depositing the waste material also dispenses the waste material in a waste

receptacle associated with each container holding support material and each container holding build material.

84. (previously presented) The solid freeform fabrication apparatus of claim 22 further comprising:

means for normalizing the dispensed layers producing waste material comprising dispensed material.

86 85. (currently amended) The solid freeform fabrication apparatus of claim 84 further comprising waste removal means to deposit the waste material in a waste receptacle associated with a container holding build material in the queue station and the hopper.

86. (previously presented) The solid freeform fabrication apparatus of claim 84 further comprising means for ejecting the container when substantially all of the material in the container have been removed.

87. (previously presented) The solid freeform fabrication apparatus of claim 86 further comprising a waste curing means for curing the waste material after the waste material is deposited in the waste receptacle, the waste material being cured by exposure to actinic radiation.

88. (previously presented) The solid freeform fabrication apparatus of claim 87 further comprising a waste closing means for sealing the waste receptacle prior to removing the receptacle.

89. (previously presented) The solid freeform fabrication apparatus of claim 85 wherein the dispensing device dispenses a build material to form the three-dimensional object and a support material for forming support for the three-dimensional object.

Patent  
USA.229

90. (previously presented) The solid freeform fabrication apparatus of claim 85 having two dispensing devices, one dispensing device dispensing a build material to form the three-dimensional object, and the other dispensing device dispensing a support material to form support for the three-dimensional object.

---